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Date: January 19, 2010

0-05-106 - 15524/US/02

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

Inventor: Joshi et al.  
Serial no.: 10/541,011  
I.A. Filed: December 29, 2003  
Title: ENHANCED GENERATION OF HYDROXYL RADICALS  
Examiner: Edna Wong  
Art Unit: 1795  
Confirmation: 9060

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Dear Sir/Madam:

**Response**

This response is in reply to the office action mailed on November 23, 2009.

**Amendments**

1. Please amend claim 1, 6 and 8 as shown in the enclosed document. The amendments aim to render the phrasing of the above-mentioned claims clearer.
2. Additional corrections in claims 1 and 8 relate to the Examiner's rejections under §112.

**Claim Rejections – 35 USC §112**

3. Claims 1 and 8 have been amended to address the Examiner's rejections, which rejections are believed to now be moot.

**Claim Rejections – 35 USC §103**

4. In the previous Office Action of 05/04/2009, the Examiner relied on Parrish to teach MgO as a catalyst to be combined with CS 274995's (CS'995) teaching, thereby making the instant technique obvious; similarly as the examiner had done in the Office Actions of 11/21/2006, 06/14/2007, 10/12/2007, 03/27/2008, 08/26/2008, and 01/29/2009.

The Examiner has now withdrawn the rejection in regard to unpatentability of claims 1, 4-6, 8 and 11-16 in view of the combined teaching of CS'995, US 6,793,903 (Parrish) and Jen et al., *J. of Chrom. A*, Vol. 796:283-288 (1998). The Examiner has acknowledged the declaration filed on October 1, 2009 is sufficient to overcome said rejection. The Examiner has accepted the conclusions of an expert in radical chemistry, who explained in said declaration that magnesium cannot replace transition metals in catalytic processes.

Although the Examiner clearly acknowledged the fact that Parrish, that mentions MgO outside the context of the instant application and of CS'995 as well, cannot be combined with CS'995, the examiner now cites another publication mentioning MgO (Nakamura). The Nakamura reference, in the applicant's opinion,

relates still less than Parrish to the instant technique, as well as to the technique of CS'995. Whereas Parrish related to MgO and peroxide, Nakamura does not even mention peroxide.

The instant technique comprises MgO, peroxide and UV; although the Examiner initially believed that Parrish related to all three of these items, it turned out that Parrish related only to MgO and peroxide without UV, and now a new citation is brought up that relates to MgO and UV without peroxide.

5. The Examiner rejects claims 1, 4-6, 8 and 11-16 as being unpatentable over CS 274995 (CS'995) in combination with US 6,194,821 (Nakamura) and Jen et al., *J. of Chrom. A*, Vol. 796:283-288 (1998). The Applicant respectfully traverses the Examiner's rejections, as explained below.

6. It is respectfully submitted that CS'995 is irrelevant for the present invention; it relates to a method for photooxidative degradation of EDTA, benzoate, or phenol in galvanic waste waters by oxygen and UV under catalysis of transition metals (page 1 of the patent). In some cases, it may be advantageous – according to the patent – to add hydrogen peroxide at initial stages (page 1 of the patent, page 3 of the translation); however, the experimental examples show that the presence of hydrogen peroxide was not essential for the process, and sometimes it even lowered the efficiency of the degradation process. We revert to Example 3 shows 90.1 % degradation in the absence of peroxide, while Example 4 shows only 79.3 % degradation in the presence of peroxide; therefore, techniques according to CS'995 do not require the peroxide, as it can sometimes deteriorate the desired outcome. It is respectfully submitted that CS'995 cannot be cited against the instant application as the two techniques have nearly nothing in common, as summarized in the following table.

	Instant invention	CS'995
Purpose	enhanced formation of radicals from hydrogen peroxide	degradation of EDTA, benzoate, or phenol
Reaction substrates	inorganic materials $H_2O_2$ , $O_2$	organic substrates EDTA, benzoate, or phenol, and $O_2$
Catalysis type	heterogeneous (oxide suspension) and UV	homogeneous (soluble salts) and UV
Catalyst metal	Mg	transition metal
pH	alkaline	?
Radicals situation	radicals cumulated to be quantified	no radicals
Use of the reaction mixture	treating ballast water or waste waters (pp 5-7)	no use

7. The Examiner now cites Nakamura, alleging that an average person skilled in the art would have learned from said publication that a magnesium oxide catalyst is functionally equivalent to a transition metal catalyst in the photocatalytic degradation of organic compounds (col. 7, lines 1-5 and col.9, lines 14-28). However, the

Applicant respectfully disagrees with the allegation of the Examiner for the following reasons.

Instant claim 1 discloses a method for enhancing the generation of hydroxyl radicals in an aqueous environment, at a neutral or basic pH, via the combination of hydrogen peroxide, oxygen, MgO, and UV. Therefore, it is clear to a person skilled in art that the technical problem to be solved is not immediate degradation of organic compounds but rather a way to enhance the generation of hydroxyl radicals in an aqueous environment, knowing the limitations of the prior art techniques, said radicals to be later applied in the purification of ballast water or waste water.

Nakamura relates to an apparatus for the decomposition of organic compounds by emission of UV light (see abstract). In the sixth embodiment of said apparatus (see col.6 line 44 to col.7 line 5), Nakamura teaches the following (underlined by us):

*FIG. 8 shows a schematic view illustrating a sixth embodiment of a decomposition apparatus F in which a route of a catalyst gas for promoting the decomposition of the organic compound is equipped to the container 82. The amount of flowing of the catalyst gas 86 is controlled by the flow control valve 89 equipped to the exit of the catalyst gas cylinder 80. The gas 74 evaporated from liquid comprising the organic compound, and catalyst gas 86 is contacted at a contact part 88 of the route 84 of the catalyst gas. The contact part 88 can be equipped with a contact material such as a net-shape material. When a pressure of the catalyst gas 86 in the route 84 is slightly higher than that of the gas 74 in the container 58, the catalyst gas 86 and the gas 74 can be contacted at just outside of the route 84 of the catalyst gas. The catalyst gas 86 may be circulated as shown in FIG. 8. A contact material with a catalyst powder may be equipped to the contact part 88 instead of the catalyst gas 86. Consequently, under the condition described above, the gas 74 is easily decomposed by emission of the UV light irradiated from the excimer lamp unit 71. The decomposed gas 85 is exhausted from the exhaust part 5 with the carbon filter 8. According to the decomposition apparatus, the efficiency of decomposition of the organic compound can be improved.*

*As the catalyst gas 86 or powder, it is preferable to use that of titanium oxide, magnesium oxide or the like, and the titanium in the titanium oxide or the magnesium in the magnesium oxide attacks the bonded part of C-Cl in particular so that the bonded part of that is cut easily.*"

First of all, in this particular embodiment which includes a catalyst being either titanium oxide of magnesium oxide, Nakamura does not teach the generation of hydroxyl radicals via said catalyst. A person with basic skills in the art of chemistry would easily understand from the above that the first step of degradation of the organic material occurs in gas phase and results directly from the irradiation of the UV

excimer. Nakamura explains earlier in the publication the effect of the UV light in the degradation process (col.6 lines 2-10):

*By the emission of UV light of wavelength of 222 nm or below, many exited oxygen atom is generated directly from oxygen in the liquid or air and have a strong oxidation force. Furthermore, since the UV light has the strong photon energy, a bond such as C--C, C--O, C--H and C--Cl of the organic compound is cut easily, the organic compound is decomposed by which the exited oxygen atoms attacks the position of the bond so that a decomposed material such as CO<sub>2</sub>, H<sub>2</sub>O or the like is generated.*

The second step of the degradation occurs either in gas phase (if said catalyst is in gas form) or on a solid support, but **never in an aqueous environment**. Nakamura teaches that the direct interaction of the catalyst with the gas containing the organic compound results in the **attack of the C—Cl bond. No hydroxyl radicals are mentioned as being generated via said catalyst** in the second step of degradation.

As to the second passage cited by the Examiner, Nakamura recites as follows:

*Next, a decomposition apparatus for decomposing the organic compound in the second mode of the present invention will be explained below. FIG. 16 shows a schematic longitudinal cross sectional view illustrating another embodiment of a decomposition apparatus J. In FIG. 16, the decomposition apparatus J comprises an excimer emission body 161 equipped with an inner electrode 35, a metal container 162 equipped to the outside of the excimer emission body 161 for filling up at least one selected from a liquid of an organic compound and a liquid containing organic compound, and a power supply for applying a high frequency voltage between the inner electrode 35 and the metal container 162.*

*The UV light is irradiated from the excimer emission body 136 by the applying of the voltage of the suitable frequency between the inner electrode 35 and the metal container 162 so that UV light is emitted to the liquid 3. The metal container 162 acts as the outer electrode shown in FIG. 3 so that the applying of voltage between the metal container 162 and the inner electrode 35 generates the high frequency discharge to irradiate the UV light. Although the UV light of wavelength of 222 nm or below is not generated the ozone in the liquid 3 or air, the UV light allows to generate the high reactive OH radical or O radical in the liquid 3. The radical cuts some bond of the organic compound so that the organic compound in the liquid 3 is decomposed efficiently to the decomposed material of CO<sub>2</sub>, H<sub>2</sub>O and so."*

It is important to notice that the above passage refers to a completely independent embodiment of the invention of Nakamura, which **does not require the**

**presence of any catalyst.** Nakamura mentions in here that the UV light alone generates hydroxyl radicals in the liquid containing the organic material to be treated, which is known.

The passages cited by the examiner show that a) Nakamura does not relate to liquid-solid heterogeneous catalysis, and b) Nakamura teaches either degrading chlorinated organic compound with the help of Mg-atom, or the formation of radicals via UV without any metal presence. No participation of MgO in an inorganic reaction resulting in the radical formation is implied.

8. Therefore, it is submitted that Nakamura neither teaches nor suggest that MgO can be used as a photocatalyst in a reaction in an aqueous phase, aiming to generate hydroxyl radicals. Furthermore, it would be evident to a skilled person, that Nakamura's reaction for decomposing polychlorinated organic compounds has not much in common with either CS'995 or with the instant technique (compare with the table in par. 6 above); instead of regular reactor and UV, Nakamura employs discharging vessel provided with electrodes, and UV laser (Summary).

Therefore, a person skilled in the art would not have any reason to combine Nakamura with CS'995, and even if incidentally combining these two techniques, said skilled person would have never expected, without the benefice of hindsight, that a suspension of MgO powder, in an aqueous environment, would work as a catalyst for the generation of hydroxyl radicals from hydrogen peroxide.

The Applicant would like to point out to the Examiner a particular remark of Prof. Meyerstein, expert in the field of radical chemistry, whose declaration the Examiner acknowledged and whose conclusions kindly accepted, reports as follows (see point #5 of the Declaration submitted earlier):

*In regard to the considered replacement of transition metals with magnesium, I must note that magnesium has a different electronic structure than transition metals, and therefore it is not a catalyst for redox processes, in contrast to, e.g., iron, nickel, and copper. Thus, no inorganic chemist will assume that magnesium oxide can replace a transition metal oxide in a catalytic process, particularly not in a Fenton type reaction".*

Therefore, in view of all the above, the Applicant submits that claims 1, 4-6, 8 and 11-16, are novel and non-obvious in view of CS 274995 (CS'995) in combination with US 6,194,821 (Nakamura) and Jen et al., J. of Chrom. A, Vol. 796:283-288 (1998).

#### Interview Summary:

We had a brief telephone conference with Nam Nguyen, supervising primary examiner, to confirm that he will review this response. If the primary examiner and the supervising primary examiner determine a final or second non-final office action will be mailed, it is respectfully requested the primary examiner and the supervising primary examiner contact us to schedule a telephonic interview prior to mailing the same. Otherwise, the applicant would appreciate a notice of allowance.

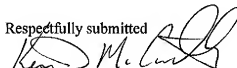
Inventor: Joshi et al.  
Serial no.: 10/541,011

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Conclusion

Following the above explanations, and the effected amendments, the Applicant respectfully requests favorable reconsideration and allowance of the claims, as all raised objections and rejections have been duly addressed.

Respectfully submitted



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